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ADDRESS

ON THE

PREVALENCE OF RICKETS

IN THE

CITY OF GLASGOW AND WEST OF SCOTLAND,

AND THE

RELATION OF RICKETS TO FOOD AND WATER USED.

BY

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Honorary Member of the Royal Ducal Society of Jena; Corresponding
Member of the Royal Society of Science of Liège; and President of the
Biological Section of the Philosophical Society of Glasgow.

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Address "On the Prevalence of Rickets in the City of Glasgow and in the West of Scotland, and the Relation of Rickets to the Food and Water used."

By James Thomson, F.G.S., Honorary Member of the Royal Ducal Society of Jena; Corresponding Member of the Royal Society of Science of Liège; and President of the Biological Section of the Philosophical Society of Glasgow.

INTRODUCTION.

It is customary for the President of each of the Sections of the Philosophical Society to offer, for the acceptance of its members, an opening or presidential address. He may either take up some branch relating to his own specialty, or he may deal with some branch which is more or less corelated, and, if possible, show wherein the relationship exists.

The department of inquiry to which I have paid some little attention, Geology, may be said to be cosmopolitan. The corelated branches are so widely diffused that, to approximately know some of the simplest problems everywhere presented to the geological student, he is brought face to face with the potent fact that his investigations lead him into, and embrace every factor, in the history of the earth.

The chemical combinations of the decomposed particles of matter are observed, their dissolution in the laboratory of nature traced, and their chemical affinities and rearrangement in differently-combined proportions noted, and the new resultants estimated. Thus, to trace the molecular dispersion, rearrangement, and co-adaptive properties of matter in its infinitesimal proportions, necessarily leads the philosophic geologist into the labyrinths both of inorganic and of the organic properties of matter. In short, there is no department of physical or biological science with which Geology is not more or less allied.

The range being thus cosmopolitan, and as an humble student of that department of scientific inquiry, I hope it will not be considered presumptuous if, in the present communication, I venture, in a sense, on the domain of the osteologist. Should there be those who regard my attempting such an inquiry as out of my province, I beg to remind such that, to approximately know a system, or even a section of a system, the geologist has not only to inquire into the peterological aspect, but he has also to observe the organic contents, and to carefully note the relationship between the organic and the inorganic constituents of that system. Further, while tabulating their relationships, he is frequently confronted with abnormal forms; and, in order to understand such abnormal conditions, he must necessarily compare the structural details of such organic remains with the organisms of the present, and, if possible, with those that are more or less related in their organization. Therefore, any abnormal aspect in the organic forms of the present has a deep interest to the geological student. His whole inquiry being inductive, he takes into consideration both normal and abnormal organizations which from time to time are exhumed from the rock-leaves of the past. And, in order to realise the structural details and their constituent parts, he must necessarily direct his inquiry as to the surrounding conditions, and the food of these organisms. If such be conceded, I will thus be permitted to inquire into the extent, and, if possible, to trace the cause of certain physical deformities that have become more common amongst the children of the present than was observed in bygone days. In doing so, from my imperfect knowledge of how it has come about that rickets are more common, I can offer no new data that will better enable us to comprehend the chemical properties that are used as food to carry on the functions of life. Neither can we trace the chemical combinations of the food, and the organic changes it undergoes, nor its dispersion throughout the different organs of the body. In seeking to know such, we are led into the chemical laboratory of nature, where the puny efforts of man are arrested, his boldest speculations are futile, and we are confronted with the potent fact, that it is but little even the most cultured mind knows. In other words, we know little or nothing of the chemical changes that take place in the human body.

When, therefore, I announce as the subject of my address to be a consideration of the alarming increase in the physical deformities of the limbs of children, and more especially the children of the labouring portion of the community, I hope it will not be supposed that I am trespassing on the domain of the Medical Profession. In attempting to trace the extent and to assign a cause or causes for such deformities, I am not insensible of the difficulties that surround the investigation, and I am well aware that the want of data regarding the physical conditions of these children in the past confronts us on the threshold of our inquiry, and that we can only be guided by culling from memory (not at all a reliable source upon which to establish data); but I conceive such calls upon memory excusable in the absence of more reliable statistical information in order to secure a ground plan of inquiry in such a department of investigation. And I further conceive that to try to solve such problems is the loftiest theme of scientific inquiry. In seeking to solve the problems of the present, reflects, and throws a flood of light upon the relics of the past.

Having thus been struck with the prevalence and alarming increase of late years in the physical deformities in the limbs of children in and around Glasgow, and the apathy both of the parents and the general public has induced me to collect statistical information, and have also inquired into the causes of these deformities. The results of my inquiries were read before the Philosophical Society of Glasgow, on 2nd April, 1884. As, however, only an abstract of the communication was printed in the Proceedings of the Society, the reason alleged for not publishing it in its entirety being that certain extracts were given descriptive of the structural character of the bones of the human body, these extracts being already published in several physiological works, and could there be consulted by those who are disposed to study these structural details. Being aware that professional gentlemen are well acquainted with these details—but I am also aware that not only are there many of the members of the Society, but also the non-professional portion of the community are not familiar with the structural details of the bones of the human body—I therefore did think that an abstract neither did meet the requirements, nor could it be expected that the non-professional could reasonably be expected to realize the importance and relationship between the food used, and the healthy growth of bones of the young and rising generation. I therefore did allow an abstract of my address to be published in the Transactions of the Society with a distinct understanding that I was at liberty to publish my address in its entirety, which I am now enabled to do through the kindness and liberality of a Glasgow gentleman who has paid considerable attention to the alarming increase of rickets among the children in the central valley of Scotland.

I.—Supposed Causes.

There is also a potent reason for my present communication apart from its scientific bearings. There is a humanitarian consideration of no mean magnitude, which must present itself to every well-wisher of the rising generation, *i.e.*, the enormous increase of this dire calamity of late years, namely, rickets in young children. And there is no problem so significant, or so important, as the fact that the increase of these deformities is of recent date; and if there be any fact, or any inquiry which is even more significant or more impressive, it is that as regards the cause or causes of this recent change in the physical aspect of the young and rising generation. As regards the cause of this new condition—so recent, so fresh, all but unknown in preceding times, so clear and close at hand—we have not as yet one single reliable reason assigned for such conditions. The ever active mind of man was never more alive or better adapted to such inquiries; but the kind of explanation needed lies in a higher and a deeper system of inquiry than has yet existed. We can assign no reason, but we see the products. The facts are these—that the physical aspects of children were more normal not at a remote period, but within the experience even of the youngest members of our Society.

The accompanying rough line engraving, from the photograph of the limbs of a little girl about five years of age, represents a bad case of rickety limbs. The femur is much curved outwards, and is greatly enlarged and curved inwards at the knee. The tibia is also curved anteriorly, and is much enlarged at its junction with the astragalus or ankle-joint.

PLATE I.

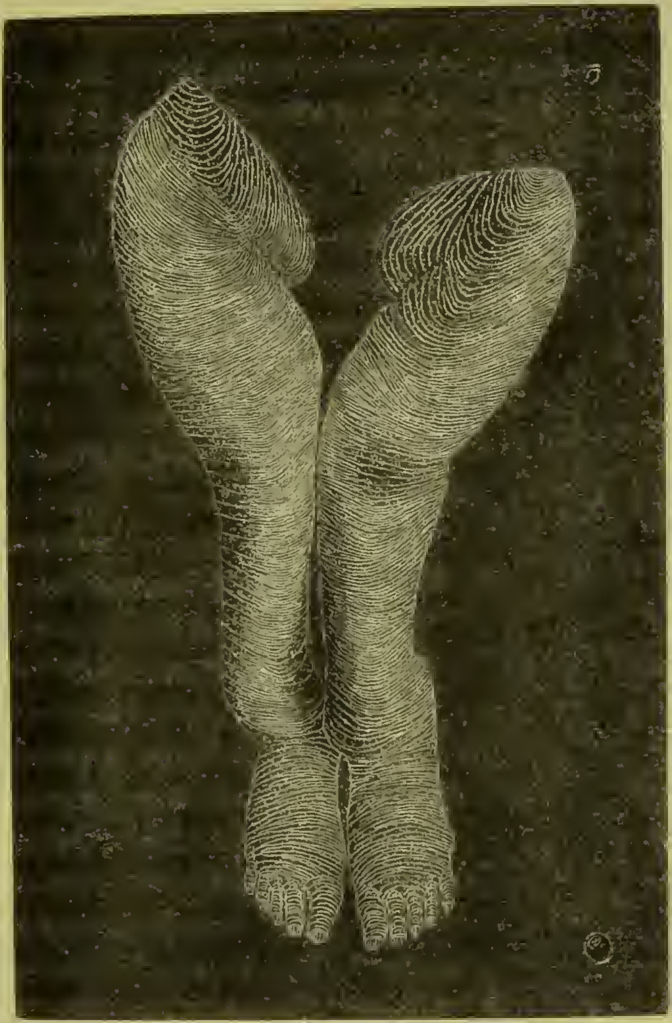
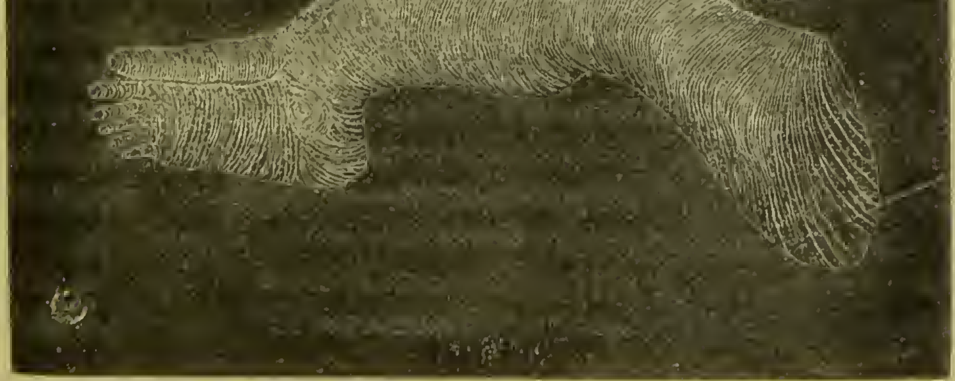


PLATE II.

Showing lateral aspect of same.



1. *Water Supply.*—Some believe that these deformities are traceable to our water supply. All know that a few years ago there was introduced a new system of water supply, *i.e.*, from Loch Katrine. We also know that its action upon lead is of a most startling character. It is well known that lime salts, one of the essential elements in the formation of bone, are all but absent in Loch Katrine water. We also know that the chemical action of the water upon lead can be arrested by the introduction of a given proportion of lime. A number of years ago I tried a series of experiments with lime, and the results were pronounced in their character. In order to illustrate that action, and how it can be arrested, I have renewed these experiments. The method pursued is simple and crude, but it will serve our present purpose. I have introduced into five glass jars, four ounces of water, into which I have introduced one ounce of lead. Into No. 1 series I have introduced into four of the vessels common carboniferous limestone, in different proportions; into No. 2 there is added a quarter of an ounce of limestone; into No. 3, half an ounce; into No. 4, three-quarters of an ounce; and into No. 5, an ounce of limestone. In the vessel No. 1, in which there is no limestone, the water became somewhat turbid in twelve hours; the experiment has gone on for sixteen weeks and it is of a milky-white colour. In the other four vessels, in proportion to the increased quantity of limestone, the turbidity diminishes.

In order, however, to test this still further, I have introduced into each of No. 2 series of vessels a similar quantity of water and lead, but instead of limestone I have added a solution of slaked lime. In the one in which there is no solution of lime there was a perceptible alteration in the colour of the water at the end of twelve hours. In the others there was introduced the solution of lime, in the following proportions:—10, 15, 20, and 25 minims. The results are equally pronounced, although somewhat different. Instead of the turbid residue we have a number of white flakes, and these decrease in number in proportion to the quantity of lime solution introduced.

In order that this should be still further tested, I introduced into another series of vessels a similar quantity of distilled water. In one of these there is simply water and lead, similar to what was used in the previous four experiments; into the others, a similar quantity of water and lead, adding 5, 10, 15, and 25 minims of the solution of lime into the different vessels. The results are somewhat similar to that of the preceding, but, if anything, the action of the distilled water is more intense upon the lead than it is in the water that is daily supplied to the community. Such results are suggestive, and provoke the question—If the water in daily use has the elements within it of such a character as to dissolve lead in so short a time, is it possible that it can influence either in retarding the growth, or softening or dissolving the bones of the human body? I am not in a position to answer either in the negative or positive, my object being simply to suggest inquiry.

Simple and imperfect as these experiments are, we have in the results the clearest evidence that the chemical action of Loch Katrine water upon lead can be arrested by the introduction of a given proportion of lime; then, if my crude experiments have not scientific accuracy, they do at least point to a remedy.

2. *Food Supply.*—There is another reason we frequently hear assigned as the cause of these abnormal conditions in the bones of children, *i.e.*, the great change in the character of the food supplied in early life. About eight years before the introduction of Loch Katrine water there was a large reduction upon the duty on tea. Since then the consumpt of tea has largely increased. Now, all know that tea, although a highly conservative article of diet and a refreshing beverage, more especially to the aged, has, however, little nutritious matter in it; it is represented to contain only about 2½ per cent. of albumen, with other constituents it contains fully 15 per cent. of tannic acid. Now, previous to the reduction of the duty upon tea, the food of the labouring portion of the community was more or less varied. In these circumstances oatmeal was largely used—indeed, it might be said to form the staple constituent of the food of the labouring classes. Now I find that since the year 1846 there has been a gradual diminution in the consumpt of oatmeal. It was in that year that the potato blight took place. The inferior quality, the high price, and popular belief that the use of the potato was injurious, necessarily produced a great change in the dietary habits of the people. Up to that period, 1846, oatmeal was the staple article of diet for breakfast and supper, potatoes were principally used at dinner. For a number of years subsequent to the potato blight the increase in price, the dread of using potatoes, and the great reduction that took place after the prohibitive duties were reduced on the importation of

grain, necessarily caused the population to seek a substitute for potatoes—which substitute was found in wheaten bread. The long-continued potato blight, and the compulsory use of wheaten flour produced a corresponding change in the dietary habits of the population, inducing a largely increased appreciation of wheaten bread. And it is to be lamented that a want of chemical knowledge in both the miller and the baker, and the haste to be rich, have fostered, and now pander to, the popular and delusive desire to have white bread. To produce such they are obliged to divest the grain of a portion of its nutritive matter, and thus the food is robbed of a portion of those elements from which the different organs of the body are formed—thus rashly and ignorantly divesting the food of those ingredients which in the chemical laboratory of Nature are dissolved, dispersed, and go to form the bones; they thus only leave in the flour those elements which imperfectly form the flesh and tissues of the body. This degraded taste has been slowly developed; and in proportion to the increased consumption of this masked deception in the form of flour, there has been a diminution in the use of oatmeal—indeed, so much so, that it is no unusual occurrence to hear of working-men's homes in which the old and nutritious article of diet, porridge, is never used—

> "The halesome parritch, wale o' Scotia's food."

Thus, in a large proportion of the homes of the community, ignorance of the ordinary principles of dietetics is rudely trampling under foot the essential conditions of a vigorous and healthy existence.

3. *Increased consumption of Sugar.*—There is, however, another article of diet the consumpt of which has largely increased of late years, namely, sugar. A few years ago the duty upon sugar was largely reduced; about that time a number of articles appeared in the newspapers advocating the delusive notion that sugar was a highly nutritive body. The use of sugar has increased to such an extent that, in the densely-populated districts, there is used a much larger proportion of sugar than there is of oatmeal—indeed, in many of the centres of industry the proportion ranges from two to ten tons of sugar for every ton of oatmeal. Now, in the food we use there are ingredients which, when brought into contact with the digestive juices in the alimentary canal, are converted into sugar before its dispersion throughout the body. The equivalents

of sugar and other ingredients are arranged in definite and proper proportions; therefore, if there is any excess of sugar in the alimentary canal, its undue admixture must have a more or less injurious effect, and I venture to state that the conversion of the excess of sugar into acid must interfere with the formation of the calcareous portion of the bones.

The lowering of the price of sugar has induced a large increase in its consumption in varied forms, not only in the ordinary household uses, but it has also fostered a largely increased consumpt of confects and jellies—indeed, the use of the latter has increased in some localities to such an extent that their use is superseding the use of butter, and there is, weight for weight, more jelly used than there is of oatmeal. And it is well known that unprincipled manufacturers of confects and jellies do not use pure sugar in the manufacture. The unnatural and unhealthy competition of the present day has induced some, not only to introduce deleterious mixtures for colouring, but also largely to use glucose, or fruit sugar, for cheapening both confects and jellies.

Now, it needs no elaborate remarks to show that if those articles are used otherwise than as nature prescribes—and more especially by the children—the beautifully equipoised balance of nature is distorted, and fails in supplying those products that go to build up the bones, and, therefore, when the pressure and strain of the superimposed body is put upon the lower extremities, it is but natural to expect that some portion of the limbs will yield and become more or less distorted.

4. *Experiments as to Effects of Strong Solutions of Sugar on Dead Bones.*—In order to know if sugar has an influence, or immediate action on bone, I have in those eight glass jars water, sugar, and the bones of the ox, sheep, pig, and human being, in the following proportions:—Into four of the jars we have four ounces of water, a quarter of an ounce of sugar, adding a quarter of an ounce of bone into each. Into the other four jars, four ounces of water, a half an ounce of sugar, and a quarter an ounce of bone. The bones have been immersed in the water and sugar since 17th of December, 1883. I find that each of the bones is more or less affected. The fatty matter is not only withdrawn, but there is also a deposition of earthy matter at the bottom of each jar. The amount of these extracted matters is largely increased in the jars in which the larger proportion of sugar is added to the water. We have thus indicated,

in these crude experiments, that bones, more or less matured, can be affected by sugar.* With such evidence, it is but a fair inference to suppose that the great increase in the use of sugar must be more or less injurious to the growth of the bones in children.

II. Statistical Inquiry.

In order that an approximate estimate may be made of the extent and character of the deformities that have of late become so common amongst the children, I have prepared a few statistics from personal observation in different localities.

The method of my observations is not by any means exhaustive; it, however, was the only means my limited opportunities would admit of, and will, I venture to hope, enable us to approximately estimate the alarming extent of the evil; and if we can evoke remedial suggestions, my crude communication, in the absence of scientific data may be of use; and if it lead to more extended inquiry, and more accurate observation, my object in bringing this subject before you will be accomplished.

The method adopted was to visit the localities afterwards to be enumerated during the earlier part of the day, when the young children were out enjoying themselves, and for the older children, either when they were collecting to attend school, or in the after-part of the day, when they are free from school. In all cases I usually counted all the children that were to be seen in each locality, and noted the deformed, and, as far as possible, the nature of the deformities. For the younger children, I confined my observations to the ages of between 3 to 7 years, and, for the older, from the ages of 7 to 14 years.

From what has been stated, you will readily understand the nature of my inquiry. In order that I may be understood, I will tabulate a portion of my observations, taking them in the order they were collected; and when noticing the nature and extent of these deformities, I will, as far as my information will admit, give a rough estimate of the proportions of oatmeal and sugar used in the different localities. You must not suppose, however, that these statistics are exhaustive; my opportunities would not admit of such. Let me here notice that, when I first began to observe these deformities, I did not note the nature and extent, as was subsequently done; I simply noted the proportion of the deformed to those presenting no abnormal conditions.

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* Since this communication was read, James Mactear, Esq., F.C.S., St. Rollox Chemical Works, has kindly analyzed the solution in which the human bone was immersed, and has found that not only the carbonate of lime, but also the phosphates are held in solution in considerable quantities. We thus have the clearest evidence that a solution of sugar will dissolve the constituents of the bones.

15th July, 1881.

In Abbotsford Place, below Cumberland Street, S.S., the proportion of deformed limbs was 1 in 14 children.

In upper Abbotsford Place, or above Cumberland Street, the proportion of deformities was 1 in 9.

In Mackinlay Street, a continuation of the latter, the proportion of deformed children was 4 in 15, or 1 in 3¾. In this street the houses consist of two apartments. In upper Abbotsford Place the houses consist of two, three, and a few with four apartments. In lower Abbotsford Place the houses consist of four, five, and six apartments.

In Bedford Street, S.S., there was 1 child deformed in 7. The houses are varied, and consist of two, three, and four apartments.

In Main Street, S.S., the proportion of deformities was 1 in 6.

In Govan Street, S.S., the proportion of deformities was 1 in 6. The houses in those streets consist of one, two, and three apartments.

27th August, 1881.

In Nithsdale Road, S.S., the proportion of deformities was 1 in 9 children. The houses consist of two, three, and four apartments.

In Main Street, Bridgeton, the proportion was 1 in 4 children, from 3 to 7 years; and 1 in 92, from 7 to 14 years. The houses are mostly one and two apartments.

In Greenhead Street, Bridgeton, there was 1 child in 9 deformed. The houses consist of three, four, and five apartments.

In John Street, Bridgeton, which extends from Main Street to Greenhead Street, there was 1 child deformed in every 3, from 3 to 7 years. The houses are small, and consist of one and two apartments; population largely employed in mills.

In Thistle Street, S.S., near the foot of the street, there was 1 child deformed in 5; ages, from 3 to 7 years.

28th August, 1881.

In the village of Carfin, Lanarkshire, which consists of one street, there was 1 deformed in every 3½ children. The population is mostly Irish; and all employed in coal mines. There is little oatmeal used in this locality.

30th August, 1881.

In Dalry, Ayrshire, there was 1 deformed in 150 children. Oatmeal is much used as porridge, and it is also largely used baked into bread.

26th September, 1881.

In Henrietta Street, Pollokshaws, there was 1 child deformed in 9. There are 8 tons of sugar used for 1 ton of oatmeal, and there is more jelly sold than oatmeal in this locality.

12th March, 1883.

Neilston, 11.20 a.m. Between the ages of 3 and 7 years there was 1 child in 15 deformed. These consisted of knock-knees and bow-legs, and in all instances they are but slightly deformed. Nearly all the cases were amongst incomers to the village. Between the ages of 7 and 14 years there was 1 deformed in 128.

In the village of Neilston there are fewer children seen upon the streets than in any other town in the central valley of Scotland, which can only be accounted for from the fact that females form the greater portion of the population, and these are mostly employed in the thread and other public works, and many of them are thus employed till they are considerably advanced in life. Tea and sugar are largely used. One merchant informs me that he sells twenty tons of sugar for one ton of oatmeal. This is accounted for from the fact that in the public works the hours of labour are from six in the morning to six in the evening, and the distance between their homes and the works is so great that they have not time to cook any other kind of food than tea. Hence the reason for the small number of deformed children and the extraordinary use of tea and sugar.

3rd April, 1883.

Hartfield Street, between the east end of Parliamentary Road and Kennedy Street. Ages of children, 3 to 7 years.

There were 40 children upon the street; 12 of these were deformed in the legs.

Three of these children were knock-kneed; with large abdomens, and the anterior portion of the heads were unusually large; 4 were curved laterally and outwards, or bow-legged, with full, broad chests; 5 were more or less curved anteriorly. There is 1 child deformed in every 3⅓. The children in this street had a sickly aspect.

3rd April, 1883.

Springburn Road, from Caledonian Railway to Sighthill Cemetery. Ages of children, 3 to 7 years.

There were 11 children upon the street; 4 of these were deformed in the legs.

There was 1 child knock-kneed; 1, the leg was curved inwards in the centre; 1, the leg was much curved anteriorly; 1, the legs were curved laterally and outwards. There is 1 child deformed in 2¾.

3rd April, 1883.

Petershill Street, off Springburn Road, 12.40 p.m. Age of children, 3 to 7 years.

There were 13 children upon the street; 4 of these were slightly deformed in the legs.

There were 2 children having legs curved anteriorly about the middle of the legs; 1 child had the legs curved laterally and outwards; bow-legs; 1 child was knock-kneed.

In this locality there are six tons of sugar sold for one ton of oatmeal. Few bake oatmeal bread. The oatmeal used is cooked as porridge. Wheaten loaves are principally used. Otherwise, these children are well cared for. There is 1 child deformed in the legs in 3¼.

30th May, 1883.

South Coburg Street, 11.30 a.m. Ages of children, from 3 to 7 years.

There were 13 children upon the street; 5 of these were deformed.

2 of the children the legs were much curved laterally outwards, or bowlie; 1, the left leg was much curved laterally outwards, and the right leg was slightly curved laterally inwards; 1, the legs were curved laterally outwards and slightly anteriorly; 1 in which the legs were much curved anteriorly, and the lower portion of the tibia and fibula were much enlarged and overlapped the astragalus and os calcis. 1 child deformed in every 2¾.*

Caledonian Road, S.S., opposite the gate of the Southern Necropolis, 6 p.m. Ages of children, from 3 to 7 years.

There were 9 children upon the street; 5 of these children were deformed.

1 of the children was badly knock-kneed; 1, the centres of the legs were curved anteriorly at an angle of about 25 degrees; this child could not walk, the head was unusually large; 2, the legs were curved laterally and outwards, or bowlie; 1, the right leg was much curved laterally and outwards about 3 inches below the knee. 5 children in 9 deformed.

7th June, 1883.

Fauldhouse Street, Rutherglen Road, 3 p.m. Ages of children, 3 to 7 years.

There were 9 children upon the street; 4 of these children were deformed in the legs.

1 of the children the legs were much curved laterally inwards in the centre, feet large posteriorly, and flat; 1, the legs were curved anteriorly about the middle; 2, the legs were curved laterally and outwards, or bowlie. There is 1 child deformed in the legs in 2¼.

Oatland Square, S.S., 4 p.m. Ages of children, from 3 to 7 years.

There were 17 children upon the street; 5 of these children were deformed in the legs.

1 of the children the legs were laterally curved outwards, or bowlie; 2, the legs were nill-kneed, large feet, abdomen large,

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* Since the abstract of my paper was published I have again visited this locality. The afternoon of my visit (21st June, 1884, 5 p.m.) was mild and warm, consequently there were a great number of children upon the street. Of these there were 21 children whose limbs I could examine; age, from 3 to 7 years; 14 of these were deformed; in some of them the deformities were of a very aggravated character.

and the anterior portion of the head is large; 2 with legs curved anteriorly, one of these was much deformed. There is 1 child deformed in the legs in about $3\frac{1}{4}$.

Braehead Street, off Rutherglen Road, near east end, 4.15 p.m. Age of children, from 3 to 7 years.

There were 8 children upon the street; 4 of these children were deformed in the legs.

1 of these children the legs were curved laterally outwards, or bowlie; 1, the legs were slightly curved laterally outwards; 1, the legs were curved laterally inwards a little above the middle of the leg; 1, the legs were curved anteriorly in the middle of the leg. There is 1 child deformed in the legs in 2.

There are 6 tons of sugar sold in this locality for 1 ton of oatmeal.

Rutherglen Road, Polmadie, 4.40 p.m. Ages of children, from 3 to 7 years.

There were 14 children upon the street; there were 5 of these deformed in the legs.

1 of these children the legs were much curved laterally outwards, or bowlie; 1, the legs were slightly curved laterally outwards; 1, the legs were curved laterally inwards near the upper end of the fibula; 1, the legs were curved anteriorly in the centre; 1, the legs were slightly nill-kneed. There is one child deformed in the legs in $2\frac{4}{5}$.

Oatmeal is bought in single pounds; there are 6 tons of sugar for every ton of oatmeal sold in this locality.

11th June, 1883.

New City Road, 10.30 a.m. Age of children, from 3 to 7 years.

There were 14 children upon the street; there were five of these deformed in the legs.

1 of these children the legs were much curved anteriorly; 1, the legs were slightly curved anteriorly; 1, the legs were curved laterally inwards below the knee; 1, the legs were much curved laterally inwards or badly bowlie; 1, the legs were slightly curved laterally outwards. There is 1 child deformed in the legs in $2\frac{4}{5}$ children.

Oatmeal is little used.

13th June, 1883.

Orchard Street, Partick, 3 p.m.

There were 10 children upon the street; 3 of these were deformed in the legs.

1 of these children the legs were nill-kneed, abdomen and feet large; 1, the legs were curved anteriorly at the middle; 1, the legs are much curved laterally, or badly bowlie. There is one child deformed in the legs in $3\frac{1}{3}$ children.

13th June, 1883.

Hosier Street, Partick, 3 p.m. Age of children, from 3 to 7 years.

There were 5 children upon the street; there was 1 child curved laterally outwards or bow-legged.

Oatmeal is little used.

14th June, 1883.

Langlands Road, Govan, 4.30 p.m. Age of children, from 3 to 7 years.

There were 11 children upon the street; 3 of these were deformed in the legs.

1 of these children the legs are curved laterally outwards in the middle of the fibula; 1, the leg is curved anteriorly above the astragalus; 1, the legs are nill-kneed, and fibula curved inwards near the middle. 1 child deformed in the legs in $3\frac{3}{4}$.

Oatmeal is bought in single pounds, and little used; there are about 5 tons of sugar sold for 1 ton of oatmeal.

16th June, 1883.

Henrietta Street, Pollokshaws, 12 noon. Ages of children, from 3 to 7 years.

There were 18 children upon the street; 5 of these were slightly deformed in the legs.

2 of these were slightly nill-kneed; 2, the legs were laterally curved outwards; 1, the legs were curved anteriorly. There is 1 child deformed in the legs in $3\frac{5}{8}$.

There are about 3 tons of sugar for each ton of oatmeal sold in this locality. Wheat flour has taken the place of the oatmeal.

20th June, 1883.

Abercrombie Street, Calton, Glasgow, 12 noon. Ages of the children, from 3 to 7 years.

There were 6 children upon the street. 2 of these were deformed in the legs.

1 of the children was nill-kneed; 1, the middle of the leg was twisted outwards and anteriorly; this child walked upon the outside of the feet. There is 1 child deformed in the legs in 3.

21st June, 1883.

Castle Street, opposite the Royal Infirmary, 11.30 a.m. Age of the children, from 3 to 7 years.

There were 5 children upon the street. 2 of these were deformed in the legs.

1 of the children the legs were curved posteriorly at the knees, the pelvic region was much projected, and the child had great difficulty in walking; 1, the legs were curved anteriorly at the middle. There is 1 child deformed in the legs in 2½.

Albert Street, off Glebe Street, Townhead, 1.30 p.m. Age of children, from 3 to 7 years.

There were 26 children upon the street. 8 of these were deformed in the legs.

1 of these children the legs were much curved laterally inwards below the knee; 1 was nill-kneed; 1, the legs were much curved laterally outwards, or bowlie; 1, the legs were curved anteriorly about the middle; 4 were more or less slightly deformed. There is 1 child deformed in the legs in 4½. These children seemed to be well cared for.

7th July, 1883.

Foot of Carmichael Street, Govan, 2.30 p.m. Age of children, from 3 to 7 years.

There were 10 children upon the street. 3 of these were deformed in the legs.

1 of these children the legs were badly curved laterally outwards, or bowlie; 1 was nill-kneed; 1, the leg was much curved anteriorly in left leg.

There is 1 child deformed in the legs in 3⅓.

There was 120 children upon the street. Age, from 7 to 14 years. 2 of these were deformed in the legs.

1 of these, a girl, was badly curved laterally outwards; 1 was slightly curved laterally outwards.

There are 4 tons of sugar sold for 1 ton of oatmeal.

20th July, 1883.

Victoria Street, Govan, 11.30 a.m. Age of children, from 3 to 7 years.

There were 32 children upon the street; 4 of these were deformed in the legs.

2 of these were curved laterally outwards; 1 was nill-kneed, and "shachly" in walking; 1, the tibia was laterally curved outwards in one leg. There was 1 child deformed in the legs in 8.

Oatmeal is much used in porridge, and some families bake oatmeal cakes. This is amongst the Scottish portion of the community. But amongst the Irish portion there is little oatmeal used, and the deformities are more frequent amongst the children of the latter than amongst the former.

23rd July, 1883.

Smith Street, Whiteinch, 12 noon. Ages of the children, from 3 to 7 years.

There were 20 children upon the street; 8 of these were more or less deformed in the legs.

4 of these children were much curved inwards in the middle of the legs; 1, the legs were slightly curved inwards in the middle; 2, the legs were curved outwards from the knee downwards; 1 was nill-kneed. 1 child deformed in the legs in every 2½ children.

There are 3 tons of sugar sold for every ton of oatmeal.

24th July, 1883.

White Street, Govan, 1 p.m.

There were 11 children upon the street; 4 of these were deformed in the legs, in which the centres of the legs were curved laterally outwards. There is 1 child deformed in 2¾ children.

There are 4 tons of sugar sold for 1 ton of oatmeal.

Victoria Street, Govan, 5 p.m. Ages of children, from 3 to 7 years.

There were 32 children upon the street; 8 of these were more or less deformed in the legs.

1 of these children was much curved anteriorly in the middle of the legs; the others were nill-kneed, and laterally curved outwards. There is 1 child deformed in the legs in every 2$\frac{6}{8}$.

There are 4 tons of sugar sold for 1 ton of oatmeal.

25th July, 1883.

Carmichael Street, Govan, 5.30 p.m. Ages of children, from 3 to 7 years.

There were 9 children upon the street; 2 of these were deformed in the legs.

1 of the children the legs were much curved anteriorly; 1, the legs were badly nill-kneed, and slightly curved anteriorly about the middle of the legs, with large abdomen. There is 1 child deformed in the legs for every 4$\frac{1}{2}$.

30th July, 1883.

Graham Street, Airdrie, 4.5 p.m. Ages of children, from 3 to 7 years.

There were 16 children upon the street; 3 of these were deformed in the legs.

1 of the children was nill-kneed and weakly in the back; 1, the legs were badly curved laterally outwards; 1, the legs were curved anteriorly about the middle. There is 1 child deformed in the legs in every 5$\frac{1}{3}$.

There are 6 tons of sugar sold for 1 ton of oatmeal.

31st July, 1883.

Whifflet, 11.30 a.m. Age of children, from 3 to 7 years.

There were 16 children upon the street.

There were 3 of these children much curved laterally and outwardly. The children in this locality are otherwise strong and healthy looking. There is 1 child deformed in the legs in every 5$\frac{1}{3}$.

There are 3 tons of sugar sold for 1 ton of oatmeal.

3rd August, 1883.

Renton, 10.45 a.m. Ages of the children, from 3 to 7 years.

There were 37 children upon the street; 3 of these children were deformed in the legs.

1 of the children the legs were slightly curved laterally outwards; 1 was nill-kneed, and weakly in the pelvic region; 1, the legs were curved laterally outwards near the base. There is 1 child deformed in the legs in 12⅓.

Oatmeal is daily used, unless by the Irish portion of the community.

3rd August, 1883.

Dumbarton, Main Street, 12 noon. Ages of children, from 3 to 7 years.

There were 12 children upon the street; 2 of these were deformed in the legs.

In 1 of the children the legs were slightly curved anteriorly and laterally in the middle; 1, the legs were curved anteriorly, and the os calcis is much enlarged. There is 1 child in 6 deformed in the legs.

There are 2½ tons of sugar sold for 1 ton of oatmeal.

4th August, 1883.

Larkhall, 1 p.m. Ages of the children from 3 to 7 years.

There were 30 children upon the street; 3 of these were deformed in the legs.

1 of the children the legs are curved laterally outwards; 1, the legs are weakly and "shachly;" 1 is nill-kneed. There is 1 child deformed in 10.

Oatmeal is used by the Scotch in porridge and cakes, but not by the Irish.

There were 120 children upon the street from 7 to 14 years; 1 of these was nill-kneed.

18th August, 1883.

Tobago Street, Calton, Glasgow, 12.30 p.m. Ages of children, from 3 to 7 years.

There were 9 children upon the street; 3 of these were deformed in the legs.

1 of the children was shachly-legged and generally weakly; 1, the legs were curved laterally outwards a little below the knee, the curved portion was about 3 inches long; 1, the legs were curved anteriorly in the middle. There is 1 child deformed in the legs in 3.

Oatmeal is little used in this locality.

15th August, 1883.

Claythorn Street, Calton, 12.45 p.m. Age of children, from 3 to 7 years.

There were 21 children upon the street; 5 of these were deformed in the legs. 1 of the children the legs are much curved inwards below the knee, and outwards immediately above the os calcis, the tarse are unusually large; 1, the left leg is much curved inwards; 2, the legs are curved laterally outwards; 1, the legs are curved anteriorly at the middle. There is 1 child deformed in the legs in every $4\frac{1}{5}$.

Oatmeal is little used in this locality.

Bankier Street, off Claythorn Street, Calton, 12.50 p.m. Age of children from 3 to 7 years.

There were 9 children upon the street; 3 of these were deformed in the legs.

1 of these children the right leg was curved laterally outwards, and much curved inwards below the knee in left leg; 1, the legs were curved anteriorly a little above the ankle, and in-kneed and wriggled much in walking; 1, badly nill-kneed, abdomen large, and pelvic region much protruded. There is 1 child deformed in every 3. Oatmeal is little used.

17th August, 1883.

Lanark, 3.15 p.m. Ages of children, from 3 to 7 years.

There were 22 children upon the street; 3 of these were deformed in the legs.

1 of the children was nill-kneed in right leg, and curved laterally outwards in left leg; 1 was nill-kneed; 1, the legs were curved anteriorly. There is 1 child deformed in every $7\frac{1}{3}$.

Oatmeal is not so much used as it was a few years ago.

18th August, 1883.

Kilmarnock, High Street, 12 noon. Ages of children, from 3 to 7 years.

There were 45 children upon the street; 3 of these were deformed in the legs.

1 of the children the legs were laterally curved outwards; 1 was nill-kneed in left leg, and curved laterally outwards in right

leg; 1, the legs are curved anteriorly in the middle of the legs. There is 1 child in 15 deformed in the legs.

Oatmeal is daily used, unless amongst the Irish portion of the population, and it is principally amongst these that the deformities are found.

23rd August, 1883.

Copeland Road, Govan, 6.30 p.m. Ages of children, from 7 to 14 years.

There were 50 children upon the road, and there was 1 boy whose legs were curved outwards in the middle; his legs were altogether weakly.

11th September, 1883.

Bellshill, West-end, 2 p.m. Ages of children, from 3 to 7 years.

There were 27 children upon the street. There was 1 child slightly deformed.

Oatmeal is largely used. 1 child deformed in 27.

Bellshill, East-end, 3 p.m. Ages of children, from 3 to 7 years.

There were 12 children upon the street; 3 of the children were slightly deformed in the legs. 1 child deformed in 3.

Oatmeal is little used. The population principally consists of English and Irish.

27th September, 1883.

Motherwell, Merry Street, 12 noon. Ages of children, from 3 to 7 years.

There were 22 children upon the street. There were 5 children deformed in the legs.

2 of the children the legs were curved anteriorly in the middle; 1 nill-kneed; 2, the legs were laterally curved outwards. There is 1 child deformed in $5\frac{2}{5}$.

Motherwell, King Street, 12.30 p.m. Ages of children, from 3 to 7 years.

There were 14 children upon the street; 3 of these were deformed in the legs.

1 of the children was nill-kneed; 1, the legs were curved laterally outwards; 1, the legs were curved anteriorly. There is 1 child deformed in $4\frac{3}{4}$.

There were 124 children upon the street. Age, 7 to 14 years.

1 of these the right leg was curved inwards.

Oatmeal is little used.

29th October, 1883.

Motherwell, 12.30 p.m. Ages of children, from 3 to 7 years.

There were 9 children upon the street. There were 2 of these deformed in the legs.

1 of the children the legs were much curved laterally outwards below the knee; 1, the right leg is badly nill-kneed, and the left leg is curved anteriorly. There is 1 child deformed in the legs in 4½.

Ages of children, from 7 to 14 years.

There are 4 tons of sugar sold for 1 ton of oatmeal.

1st November, 1883.

Huntingdon Place, St. Rollox, Glasgow, 1 p.m. Ages of children, from 3 to 7 years.

In this place every second child is deformed, representing every form of deformity.

Ages from 7 to 14.

There were 51 children upon the street, and 1 girl, about 10 years of age, the legs were slightly curved anteriorly.

Oatmeal is seldom sold in this locality.

6th November, 1883.

Strathaven, North side of Town, 3 p.m. Ages of children, from 3 to 7 years.

There were 6 children upon the street; 2 of these were deformed in the legs.

1 of the children the legs were badly curved laterally; 1 was nill-kneed and weakly in spine. There is 1 child deformed in 3.

There are 4 tons of sugar sold for 1 ton of oatmeal.

29th November, 1883.

St. James' Street, Kingston, Glasgow, 11.30 a.m. Ages of children, from 3 to 7 years.

There were 14 children upon the street; 5 of these were deformed in the legs.

3 of the children the legs were curved laterally outwards; 1, the right leg was curved posteriorly; 1 slightly knock-kneed, legs weakly. There is 1 child deformed in 2¾.

Oatmeal is little used.

Crossford, near Lanark.

A gentleman of that village informs me that there has not been a native child deformed in this village for the last 40 years. There was 1 deformed child brought into the village about 4 years ago, whose parents were Irish.

Oatmeal is used twice daily.

Stornoway, Outer Hebrides. I have been unable to learn of a single case of deformed legs in that town.

Oatmeal is much used.

Islay. Dr. M'Indeor informs me that there has not been a native child deformed in the legs for 30 years. About 28 years ago there was a delicate child, with deformed limbs, brought from Glasgow to Islay. The parents were poor and were obliged to use oatmeal, at least twice daily. Their child not only regained health, but the legs became normal, and he is now as well formed in the legs as any man in Islay.

Oatmeal is used in Islay, at least twice daily.

Now, these malformations have been attributed to causes of a very varied character. All, however, are grouped under the name of "Rachities," and is generally understood to be induced from the absence of mineral matters in the food in those definite proportions that are necessary for the formation of bones.

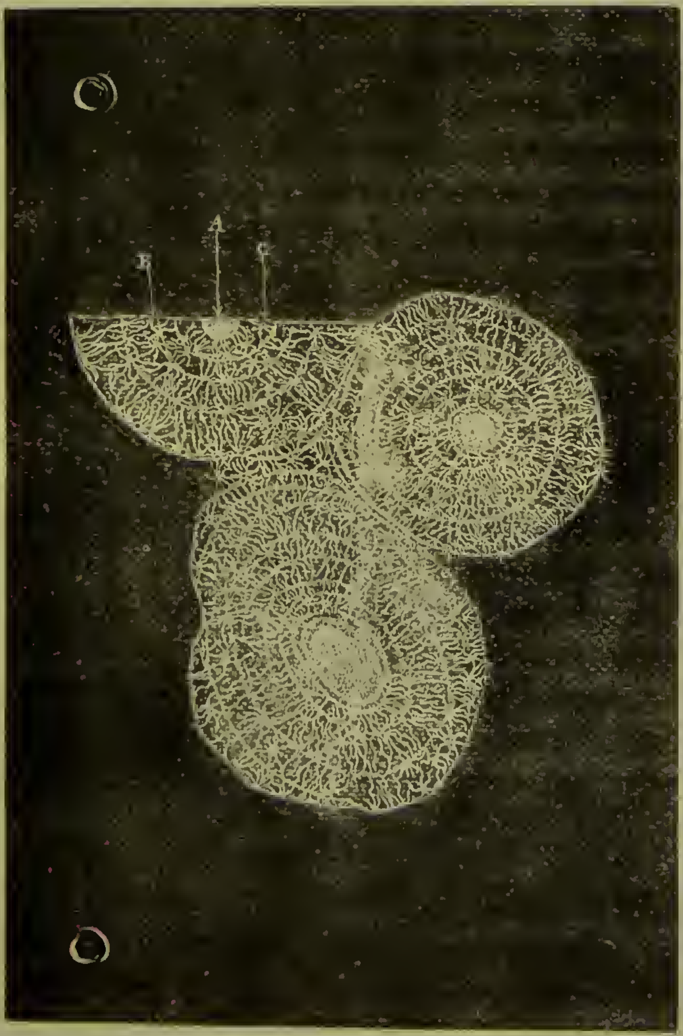
In order that we may realise the importance of food and its relation to the growth of bones, allow me briefly to recapitulate the descriptions of a few of the details of the structural character of bones; and in order that I may place them before you, as clearly as my limited knowledge will permit, I have prepared transverse sections of several bones, and have delineated upon copper a transverse section of bone, exhibiting the normal condition of the structural character (Plate III), and have been able, through the kindness of R. Cochran-Patrick, Esq., M.P., LL.D., F.A.S., to prepare and examine a transverse section of the humerous of prehistoric man. In order that we may be enabled, as far as possible, to trace the relative conditions of the bones of man who lived in primitive times, when his only food was that which was indigenous, and which he could only procure in his own immediate neighbourhood, I have also prepared sections of the bones of man of more recent times, whose food is more varied, and is not confined to the products of our own country. Also, through the kindness

ness of Dr. MacEwan, of the Royal Infirmary, I have been able to prepare sections of a rachitic bone (Plate IV.), also a section of the bone of a very young child, or rather a diseased bone, in the cartilage condition, which exhibited the mammilated protuberances such as is usually present on the surface of rachitic bones (Plate V.), which may be summarized as follows:—

(1) In a section of the bone of prehistoric man there is a marked distinction in the structural details; the laminæ which surround the canals are secreted in the most precise and regular manner.

(2) In a section of a bone of recent times the structural details are more or less spasmodic, the cellular tissue is not so uniform, and the laminæ are not so regularly disposed (Plate III).

Plate III.

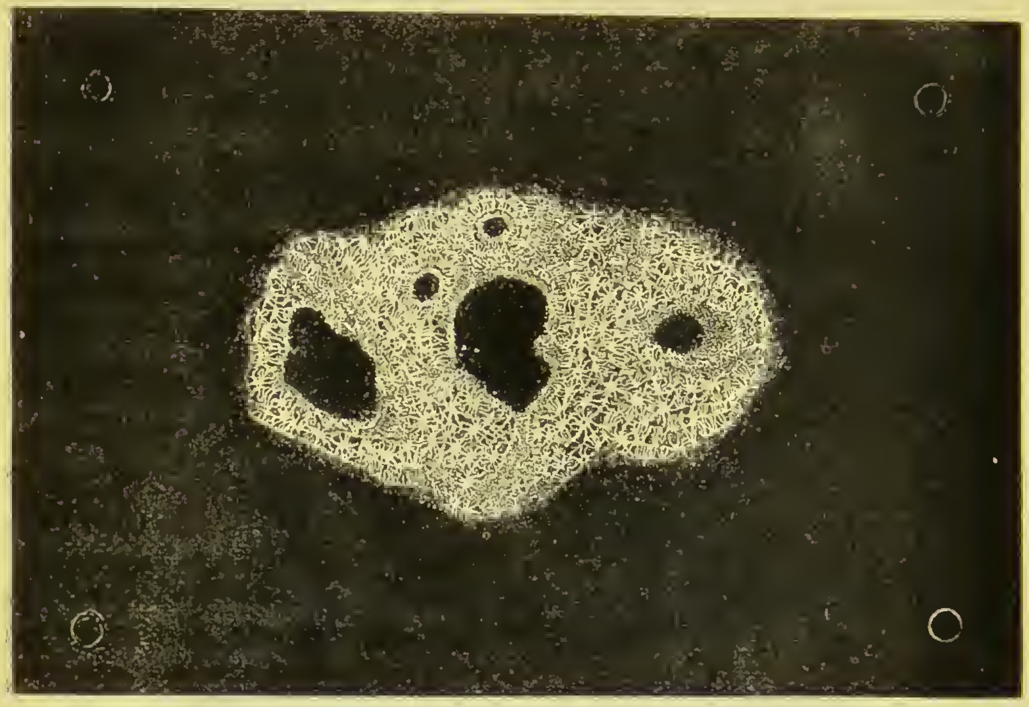


James Thomson Del.

(3) In a section of the rachitic bone the structural details are extremely irregular; and, instead of the delicate lamellar plates

which surround the canals in healthy bones, these apertures are surrounded with irregularly disposed granular tissue (Plate IV.)

PLATE IV.



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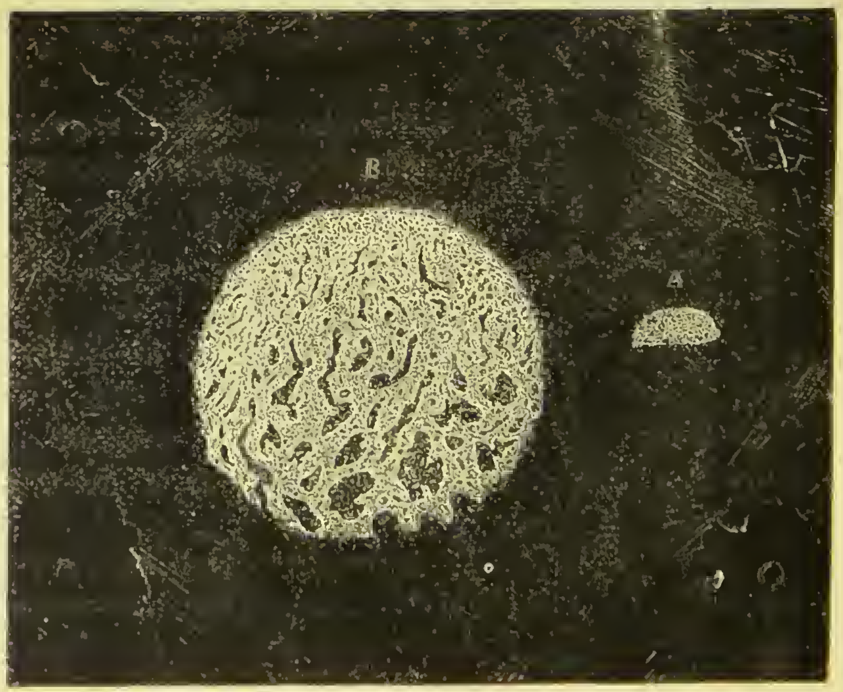
(4) In a section of a rachitic bone, in the cartilage condition, the structure presents an irregular mass of open cellular tissue (Plate V.) Fig. A nat. size. B a small portion of it enlarged.

PLATE V.



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STRUCTURE OF BONES.

Before referring to the structural details of bones, permit me to remark that there is a great want in our public institutions in the absence of both longitudinal and transverse sections of the different bones of the human body. It seems to me that it would be highly advantageous to the students of this department of inquiry, if, along with a complete series of the bones of subjects of different ages, that there ought to be a series of both longitudinal and transverse sections of each of the bones. As I have frequently stated in my communications to the Society on Corals, that in order to know the character of a coral, it is absolutely necessary to section the specimen at different parts of the corallum. In order first to know the structural character of the form we are investigating, and also to know how these details were formed. In like manner, before a student can acquire even an approximate conception of the structural character of bones, there must be a complete series of sections of both healthy and of diseased bones conspicuously situated in the osteological department of all our anatomical museums. Such a series ought to embrace bones of all ages, beginning with the fetal or cartilagenous condition, extending throughout the series to that of adult, and aged. With such data to guide, students could hope to acquire a knowledge of the structural details, and an approximate estimate of how formed. Along with such a series, if there was a list of the tabulated results from experimental evidence of effects produced from different kinds of food, and with full details of their composition, there would be no difficulty in suggesting the proper kinds of food, not only for children, but also for adults.

Gambgee, in his *Physiological Chemistry of the Body*, states*:—

> " It is well known that the bones of the human body are invested with a fibro-vascular membrane, the periosteum, which conveys to them the principal proportion of the blood-vessels which supply them, and which contains on its inner layer certain cell osteoblasts which are the active agents in the growth of bone, and in virtue of which the periosteum possess the power of forming bone.
>
> " The external part of bone has a dense structure, the interior is either hollowed out into a cavity termed the medullary cavity, or is occupied by a trellis structure of boney plates which constitute the cancellated tissue.
>
> " The medullary cavity lodges the medulla or yellow marrow, which is

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* Vol. I., page 272.

composed of fat cells supported by a frame work of connecting tissue, and abundantly supplied with blood-vessels; the cancelli or spaces of the cancellated tissue afford support to the so-called red marrow, which is a tissue in which a large number of cells identical with the colourless cells of the blood are found, besides certain cells which resemble the nucleated coloured corpuscles of embryonic blood.

"It also contains large cells with many nuclei to which the name myeloplaxes is applied, and which are identical in appearance and probably in functions with those cells which under the osteoclasts are supposed to be the active agents in the formation of the medullary cavities of growing bone; though the chief blood-supply of bone is drawn from the periosteum, both arteries and veins of considerable size enter by so-called nutritious foraminna, and are distributed to the marrow and so-called endosteum as the connective tissue lining the medullary cavity is called; some of the branches of the nutrient vessels anastomose with the blood-vessels of the hard tissue.

"The blood-vessels embedded in the hard substance of bone lie in canals—the Haversian canals (Plate III., A). Around these canals the bone substance is arranged in concentric lamellæ. In these lamellæ are cavities, also arranged concentrically, called lacunæ (Plate III., B), and from these proceed minute canals—the canaliculi (Plate III., C)—which establish a communication between adjacent lacunæ, and between the lacunæ which are in the circles nearest the Haversian canal and the canal itself. The lacunæ lodge nucleated masses of protoplasm—the bone corpuscles, or bone cells—which do not send processes into the canaliculi.

"The walls of the calcified lacunæ and canaliculi, as well as of the Haversian canals, appear to be composed of a tissue resembling elastic tissue,[1] and are left surrounding the bone cells when softened bone is boiled for many hours in water, or when it is subjected to digestion with trypsin,[2] and in transverse section are seen to consist of concentric layers; these layers are traversed by minute tubes or lacunæ, and the communicating canaliculi."

By this means the blood, with the different elements, permeates the bones, both longitudinally and transversely, thus adding and increasing the size and form of the bones. It will thus be apparent that the Haversian, and other cell walls, absorb from the blood the materials of which they are composed; and unless the blood is constantly supplied with those ingredients, the bones cannot receive the necessary proportions of which they ought to be composed. And all know that that supply can only be procured from the use of nutritious food. Now, the food that is largely used (wheaten bread) being divested, by the so-called modern improvements, of the constituents so beautifully proportioned by natural law, and there being almost nothing left but the starch or gluten, there must necessarily be a corresponding diminution of the consistency and strength of the bones.

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[1] Hoppe Virchow's Archive, Vol. V., p. 170, 1853.

[2] De Borgh Birch "Erscheinungen bei Trypsinverdauring au Knochan," Centrac-blatt fid med, Wissenchaft, p. 941, 1879.

CHEMICAL COMPOSITION OF BONES.

The chemical constituents of bones consist essentially of two elements—the mineral matter, which gives stability to the skeleton, or framework, the soft animal matter, which not only gives elasticity, but is also a medium through which the constituent elements are conveyed through the cellular structure of the bones.

The mineral matters of bones are deposited in the organic basis in such a manner as to be invisible in microscopic examination, and consist principally of phosphate of lime, with about a fifth part of carbonate of lime, and a small proportion of fluroide of calcium, chloride of sodium, and magnesium salts.

The proportion of earthy or saline matter of bones is about two-thirds, or as Quain has given it "66·7 per cent., and of animal matter one-third, or 33·3 per cent. These proportions, however, differ in different individuals, yea, even although placed in similar conditions." The cause or causes can only be guessed. No accurate data, founded upon experimental evidence, can as yet be given. It is, however, well known that there is a much larger per cent. of mineral matter in the bones of adults than there is in infants; but until there is reliable data, both as to rate of increase of the earthy matters from the absorption of the cartilage, and the aggregation of the earthy matter in the fetal condition, and the proportionate rate of increase during the various periods of life, all must be very much a matter of conjecture. It is well known that the bones of children are considerably more vesicular than in adults. That such should be so is in consonance with the ordinary conditions of organic life, and a very important factor in permitting the growth of the osseos matter during the earlier stages of development.

"Milne-Edwards considers that carbonate is formed from the decomposition of the basic phosphates of the carbonic acid of the blood, and that the proportion must necessarily vary with the state of nutrition. In infancy there is less decomposition, and also more rapid elimination of the products of decomposition, hence proportionately less carbonate of lime."

The following exhibits the probable composition of the mineral matters of bone, calculated from the analysis of Zalesky:—

Calcium phosphate ($Ca_3\ 2\ PO_4$),	83·889
Calcium carbonate ($CaCo_3$),	13·032
Calcium in combination with fluorine, chlorine, and organic acids,	·350
Fluorine,	·229
Chlorine,	·133
	98·722

RACHITIS.

Change of Bone in Rachitis or Rickets.

Gamgee states—

"Rachitis is a general disorder of nutrition, accompanied by changes especially affecting the epiphyses of bones.* An abnormal proliferation of cartilage cells, whilst the growing bones, being deficient in earthy matter, become distorted. When calcification occurs, the deformities which have been produced are often rendered permanent. It is a disease which affects bones in the process of development, or rather cartilage which is being converted into bone, and it therefore differs fundamentally from osteomalacia, in which a morbid process causes the absorption of the salts of fully-formed bone, and further serious changes in the decalcified framework.

"In rickets the bones become specifically lighter than in health; the unossified cartilage contains an increased proportion of water; the long bones contain an increased quantity of fatty matter. The amount of fat is, however, much less in the bones of rachitis than in those affected with osteomalacia. It has been found by Lehman and Marchand that occasionally in rickets the bones do not yield a normal proportion of gelatine when boiled."

Composition of Bone in Rachitis.

	Femur, Marchand.	Tibia, Lehman.	Humerous, Ragsky.
Inorganic Matters,	20·60	33·64	18·88
Organic Matters,	79·40	66·36	81·12
Calcium Phosphate,	14·78	26·94	15·60
Magnesium Phosphate,	0·80	0·81	
Calcium Carbonate,	3·00	4·88	2·26
Soluble Salts,	1·02	1·08	0·62
Fats,	7·20	6·22	81·12
Collagen,	72·20	60·14	
Calcium Flouride and loss,	1·00	0·99	

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* Phys. Chem. of the Animal Body, Vol. I., p. 281.

Gamgee* further states that—

> "We shall probably form a nearly correct idea of the essential nature of rachitis if we look at it as a morbid process having its seat in the ossifying epiphyses, and in newly-formed bone, a morbid process which is a local expression of a general disorder of nutrition. As a result of the latter, the cartilage cells undergo an abnormal proliferation, and the newly-formed bone cells are more or less unfit to separate from the blood the lime salts which are needed for the hardening of the newly-formed ground substance in which they lie. As a result of the excessive proliferation, and because, as they grow, they do not concomitantly harden, they yield to external pressure, and become deformed."

Indeed, recent observations yield abundant evidence that there is a predisposition inherent in some children, although not apparent. In such cases the general good health of the parent, and the immediate surroundings of the child being highly conducive, and calculated to carry the patient through that period when the "Ossious tissue" is deposited, provided there is no undue strain to prevent the healthy growth of the child, such as acute disease that would undermine the vitality before the system has had time to illiminate the inherent disorder, and in some cases it is only after the patient had gone to work, and exposed to a vitiated atmosphere, and only when the extra strain was put upon the system did the disorder assert its presence. Indeed, several years may elapse before there is any outward indication of inherent disorder; numerous instances could be given; there were two recently in the Royal Infirmary. Through the kindness of Dr. MacEwan I was permitted to be present with him on one of his receiving days, when amongst the numerous applicants for admission, there were two to which I will refer. The first was a little girl, badly bowlie; the Dr. requested the child to walk a short distance; the child had not walked from us more than three paces when the mother exclaimed that there was nothing wrong with the child till after it had the measles; the Dr. then told me there was many such cases.

The second was a young man, a mill-worker from Bolton; this patient was badly knock-kneed. He stated that there was nothing wrong with his legs till after he was eleven years of age, or not till the strain of the superimposed body from hour to hour and from day to day was placed upon the limbs; then, and then only, did the disorder show indications of its inherent tendency.

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* Vol. I., p. 284.

That the blood is the medium which conveys the dissolved matter of which the bones consist, there can be no reasonble doubt. It cannot however be recognised in a liquid state, but rather it forms along the lateral margins, and at the extremities of the "Haversian lacunæ and canalicular canals," by the union of its constituents present in solution, and forthwith by the chemical affinity of its constituents which combine and secrete the laminæ that surround these cavities.

It will thus be apparent that the connection between the blood and the bones is of an extremely intricate and close relation, and furthermore, that the formation of bone is also due to the nutrient properties of the food used. Indeed, if other evidence was wanting, the interesting experiment referred to by Quain,* in order to test the relationship of the growth of bone, and the food supplied.

"Madder was introduced into the food of an animal which acted as a sort of a mordant, it united with and fixed the colouring matter in that portion of the bone that was deposited during the admixture of the madder with the food, by this means the newly formed bones were more deeply tinged than the older portion showing how the new osseous growth can be readily distinguished from the old."

With such data there can be no reasonable doubt that, with careful observations and attention to the food of children, the results would be highly advantageous.

ETIOLOGY AND PATHOLOGY OF RICKETS.

"Very different views have been advanced on the etiology and pathology of rickets.† Patit first suggested that the disease is caused by the too early weaning of infants.‡ Since his time others with no less reason have maintained that too prolonged lactation often acts as a predisposing cause, the impoverished milk being incapable of supplying the growing infant with all the materials which its organism requires."

With the view advocated by Patit I have the greatest sympathy. Little requires to be stated to convince the most casual observer that if the child loses the food that nature has provided, it must suffer in a proportionate degree. With the views of the latter I have no sympathy, from the fact that in most of the localities where rickets amongst children are seldom seen (outer Hebrides), the children are kept longer suckling than is found in any other part of the country.

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* Quain, Anatomy, seventh edition, vol. 1, page 92.

† Gamgee, Physical Chemistry of the Anatomical Body, vol. 1, p. 282.

‡ Patit, Traite des Maladies des os, 1741.

Whilst some have considered that rickets is induced by an improperly adjusted diet, in which the different varieties of food constituents are not in their proper proportions. A view which requires no arguments of mine to support. If the necessary constituents are not in the food, is it possible that the blood can yield what it has not received?

A majority of writers have advocated the view that the disease especially depends upon a deficiency in the lime salts of the food, or in a deficient absorption of lime salts—a view which the citizens of Glasgow may well pause to consider, from the fact that it is since Loch Katrine water was introduced that this disorder has become so prevalent. Not that I believe it is the cause of these disorders, but conceive that it is within the range of probability that it is a cause. We have seen how it affects lead, and conceive that the sooner we try to remedy this cause, infinitesimal though it may be, the better, and more especially when remedial measures can be adopted.

It may be asserted that the absence of lime in the water supply can have little if any influence, from the fact that when water is boiled, the lime salts do not remain in combination with the water, but rather, that these obey that beautifully equipoised law of nature, *i.e.*, that, when the temperature of water is raised above its normal condition the lime salts are separated and fall to the bottom, and become segregated, and form what is popularly known as furr. But allow me to remind such that, with all kinds of food which are cooked in combination with water, there is a chemical affinity between the great majority of these foods and the lime salts; these combine with the food, and are thereafter dispersed throughout the body by the blood, and thus become incorporated with, and aid in forming the cell walls of the bones.

"All these views have been supported by experimental researches which have led to diametrically opposite conclusions. Certain experimenters having, for instance, succeeded in inducing rickets by feeding young growing animals on meat instead of milk; others, by cutting off the lime salts more or less completely (*Setellier von Bibra, Chossat, Milne Edwards*); whilst, not a few have found that, although the animals subjected to these conditions suffered in health, and even died, they showed no symptoms of rickets (*Léon Tripier*,[*] *Weiske*).[†]

"We think, from a careful perusal of experimental evidence bearing on this question, that we may draw from it the following conclusions:—When young animals are subjected to insufficient diet, or one in which certain of the alimentary constituents are deficient, there is engendered a predisposition to rickets, although there is no evidence to show that such insufficient or improper diet can, acting alone, induce the disease."

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[*] Léon Tripier, in note 3, p. 282.

[†] Weiske Zeitschrift F., Biologie, Vol. VII., pp. 179, 183, 333, 337.

In addition to the influence of the kind of food and water used by the labouring classes, other influences have been supposed to operate in the production of rickets, such as the effects of habitually breathing a vitiated atmosphere, living in houses built on a damp soil, careless nursing, &c. Let us consider some of these influences.

Effects of Impure Air.—Some have asserted that the great increase in the deformities of the limbs of the children is largely due to impure air. Such have some grounds for their opinion. During my investigations I have found that in those localities where the children are daily inhaling air vitiated with every impurity these deformities are of a very aggravated nature. In addition, the skin of these children indicates an unhealthy condition, and impresses upon the observer the conviction that there is an intense struggle for life, and that it is only the strongest of them that we can reasonably hope will survive. Even amongst these, in after life, the impress of their early surrounding is ever apparent. We must, however, seek some other cause or causes to account for this abnormal condition, as in several of the localities enumerated there is no want of pure air. In Caledonia Road and in some of the country villages the houses they inhabit are only built on the one side of the road or street. Under such conditions there is nothing to interfere with a constant supply of pure air.

Effects of Damp Sub-soil.—Some have suggested that the damp sub-soil may have much to do in inducing such deformities. I believe that the sub-soil has a great influence on the healthy upbringing of children, more especially in many of these speculative-built properties, where the sub-soil is cold boulder clay. The foundations of many of these houses are often not more than from 12 to 15 inches below the surface; necessarily, the ground flats are always damp, and the exhalations of the damp ground flat penetrates and permeates the whole property. The atmosphere is thus vitiated, and the children are exposed to and inhale the sour, damp air, impregnated with the concomitant impurities of such untenantable dwellings.

Effects of Bad Nursing.—Some have suggested careless mothers and bad nursing as the cause. This may be, and I believe is, the cause of not only many of these deformities, but is also the root and source of hundreds of shattered and ruined constitutions that are from year to year thrust as burdens upon society. It is, however, only in a limited number of cases that we can trace these abnormal conditions to the mother's neglect. Improper nursing by no means accounts for all; the cause is deeper rooted, because there are hundreds of children deformed whose mothers are attentive and well disposed, to whom their deformed offspring is a great source of grief. If anyone wishes assurance on this point let them attend the Royal Infirmary on any of Dr. MacEwen's receiving days, and there they will find mothers whose external aspect indicates thrift and care in a marked degree, but in whose faces may be detected internal emotions of a pronounced character. Every word emanating from the doctor's lips is weighed, and every look watched with an anxiety that tells plainly that if she could mitigate or arrest this sad condition no effort would be spared to attain such a wished-for result.

Personal inquiry as to food used in a working man's family.—In order that we may more fully realise the importance of the home influence upon this sad disease, let us go to their homes and see their surroundings, and learn how these children are being cared for, and what kind of food they are in the habit of using. As a fair representation, I have selected three localities—two in Glasgow and one in a country village. The first is in Claythorn Street, Calton, where I entered the home of one of these deformed children. The mother was actively engaged with her household duties. I introduced myself, apologising for thus obtruding, and assuring her that my visit was for the purpose of collecting facts regarding these deformities that are becoming so common in the limbs of children, and which I was sorry to see in one of her little ones; and I politely requested her to aid me by giving any information she could, and to answer a few questions regarding the food in daily use. I was fortunate in my selection, and was met with a willing and ready response from a mother whose children were clean, and whose house indicated thrift and carefulness.

Q. What age is your husband?—A. He is 26 years past.

Q. How long have you been married?—A. Seven years.

Q. How many children have you?—A. Three.

Q. Is your husband about the same age as yourself?—A. He is about a year older.

Q. What does he work at?—A. He is working in a ship-yard in the west end; he was working in a mill before, but the mill was burnt and he then went to the ship-yard.

Q. Were you employed in any public work before you were married?—A. Yes, I wrought in the same mill.

Q. When did you begin work in the morning?—A. Six o'clock.

Q. How long did you get for your meals?—A. An hour.

Q. How far had you to go for your food?—A. About a mile.

Q. With only an hour, and having nearly a mile to walk, you could not have much time to cook food?—A. No; we had only as much time as to boil a little water to mask a cup of tea.

Q. What kind of bread did you use chiefly?—A. Loaf-bread.

Q. Was your husband's food similar to your own?—A. He had a much longer road to go, and he brought some loaf-bread and butter with him, and took his breakfast inside the gate.

Q. What did he get for dinner?—A. He sometimes went up to the cook-shop and got a penny bowl of broth, with potatoes and potted-head, and sometimes he brought as much loaf-bread and tea as did for his dinner too.

Q. What did you take for dinner?—A. Sometimes we got potatoes and ham, and at other times we got tea.

Q. What did you get for supper?—A. We had tea, with loaf-bread and ham, or sometimes fish.

Q. Since you were married, how does your husband do for his food; seeing the distance is so great, he will not get home for any of his meals till evening?—A. He gets a cup of coffee before he leaves in the morning about a quarter-past five, and takes a piece and cold tea with him for his breakfast; for dinner he goes to the Cooking Depot and gets a bowl of broth, with potatoes and meat, and when he comes home I always plan to have something as nice as I can give him to his tea.

Q. As for yourself and children, what do you prepare for breakfast?—A. I usually give them a cup of tea and a piece of loaf, spread whiles with butter and sometimes with jelly.

Q. And for dinner what do you usually give them?—A. I often give them potatoes and meat (butcher meat), but on washing-days, or when I am cleaning, I give them a jelly-piece for a "pit-ower."

Q. Do you ever make porridge for them?—A. Well, I have sometimes tried them with porridge, but none of them will take them, their hearts turn at them, and I just give them a jelly-piece to coax them to eat.

Q. Do you never use oatmeal cakes?—A. Sometimes I buy a penny-farle, but they are so hard that none of us can eat them.

Q. When did the oldest child's legs become deformed?—A. Her legs were quite straight and a nice bairn till she had the measles and whooping-cough, after that she took a dwining and was dowsie for a long time, then her legs got weakly and grew bent as you see them.

Q. Are the other two children healthy and strong?—A. The youngest is a nice, healthy bairn; but the wee laddie—the second—has been dwining since he had the measles, and I often give him a jelly-piece to coax him to eat.

Such is a brief outline of answers given to a few of the questions put to a highly-respectable mother, who seemed to have for a husband a well-doing working man—indeed, their home had all the indications of thrift, and that their earnings were spent to the best advantage as far as their knowledge went.

Regarding the other two cases referred to, I need not go over a similar series of questions and answers. In general, the answers were much alike.

The other City case referred to is in Oatlands, South Side. This family live in one of the speculative-built properties; the houses are far from being what they ought to be; the tenants are no better—indeed, squalor and misery reign supreme. In this home oatmeal is never used; wheaten bread, if it can be called bread, and potatoes are the principal articles of diet. The children are not only deformed in the limbs, but the general appearance is unhealthy—their skins are dry and have a yellowish-grey colour.

The other case referred to in the country is at Carfin, where there is no want of fresh air. The houses are built on the side of the public highway, and surrounded by green fields. The men are employed in the coal mines, and are usually absent from their homes from early morning till the afternoon. The house entered was simply a den of squalor and misery; there was scarcely an article of furniture in it. The mother was untidy, and the children were unwashed, and all indicated that every feeling of thrift and well-being had been crushed out of the inmates. Oatmeal is little used; tea and wheaten bread are the principal articles of diet varied with potatoes.

Such is a brief outline of the conditions of many of the homes out of which these poor, helpless, deformed, little fellow-creatures come—they are simply nurseries of disease.

Why do working people use improper Food?—The question has been put to me—Do not many of those people believe that as articles of diet, tea and wheaten bread are cheaper, and in consequence of their ignorance of the laws that regulate the healthy upbringing of children, do they not use these substitutes for the sake of economy? My answer to such a question is—I do believe that some do use such as food on economic grounds, but with others no such prudential thoughts pass through their minds.

Well, but many say their children have a dislike to porridge, and will not take it. Whether they dislike it or not very much depends upon the care the mother has bestowed upon the teaching her children what and how to take. There is a natural inclination in all children to grasp all kinds of food that is conveyed to the mouth. Indeed, in infancy, children attempt to grasp the mamma of the mother; and if a child is allowed, before a taste for porridge is acquired, to sup by itself, it is quite a common occurrence to see the child attempting to grasp the porridge to convey it to the mouth. Failing to satisfy its own desires, it is no uncommon occurrence to see the little one thrust all from it in disgust.

Let the mother, however, cook the porridge properly, and teach the child to sup it before it becomes cold, and there is no fear of the child not relishing it. But, in order to acquire a knowledge of cooking simple, plain food properly, she must be taught in her early days. I venture to think that if there were more attention paid to the nutrient properties of diet, and greater care exercised in the cooking of simple, plain food, there would be fewer deformed children than are now seen in our midst. And I conceive that if the results of the lately-formed cooking schools were at all commensurate with the intention of the generous founders, instead of teaching the pupils to cook pastries and such like indigestible dishes, if greater attention were paid to the proper method of cooking the simple and more nutritious diet, that is not only more wholesome, but is also cheaper, and more compatible with the wants of the body, such institutions would become a boon both to present and future generations. More I do not wish to say on that point, but rather leave that department in charge of our School Board authorities and cooking schools.

Cost of food of working people: a comparison.—In order, however, that this may be put on as clear a basis as our knowledge will admit of, let me compare the relative cost of each.

Take, for example, a family of three children. Let us cut a quartern or two-pound loaf into seven parts, the cost of which is 3½d., which is ½d. per part; add to each ½d. worth of butter or jelly; give to each of the three children one of these parts, costing 1d. each, or 3d. in all; allow $\frac{1}{2}$d. for tea and $\frac{1}{2}$d. for sugar, 1d., or 4d. for the meal for the three children, or 1$\frac{1}{3}$d. for each.

Now, instead of tea and bread, let us try what will be the cost of a basin of good porridge and milk.

Take one pound of oatmeal, which costs 2d.; boil it well in water, with a little salt added; when sufficiently boiled it will fill eight small basins, costing $\frac{1}{4}$d. each. Give to each of the children a $\frac{1}{2}$d. worth of milk; costing in all $\frac{3}{4}$d. for each child's meal. We have thus a much more nutritious meal at an average cost of $\frac{3}{4}$d. than we have in the former at an average cost of 1$\frac{1}{3}$d., so that the more nutritious and more easily digested of the two diets is the cheapest.

Such is but a brief outline of what takes place from day to day and year to year. If time permitted, I might have adduced hundreds of cases bearing testimony to similar conditions.

During my investigations as to the extent of these deformities I have, as far as possible, sought to know what kind of food is used in the different localities, and I have arrived at the following conclusions:—

(1) In proportion to the use or disuse of plain wholesome food there is a proportionate increase or decrease of rickets.

(2) In those localities where white wheaten bread, sugar, and tea have taken the place of the old nutritious porridge and milk for children's food rickets is prevalent. Indeed, in some of these localities every second child between the ages of 3 and 7 is deformed.

(3) Where oatmeal is largely used the disease is seldom heard of. In Crossford, Lanarkshire, that article of diet is used both morning and evening, and there has not been a single native case for fully forty years. We have found similar testimony in the West Highlands—in Lewis, Skye, Mull, Islay, &c. Where oatmeal forms the staple article of diet, I am informed that the biggest boned and broadest chested men are found. (This, I understand, refers more particularly to Aberdeenshire and Morayshire), where the agricultural classes use oatmeal as their chief, almost their only diet.

(4) Where oatmeal is seldom or never used we have found that the children are deformed, and in many cases they are helpless objects, unfit to follow any of the ordinary avocations of life.

With such startling conclusions before us, I venture to say that it behoves every well-wisher of humanity to lend his aid, and, if possible, suggest remedial measures.

Thanks to the successful efforts of Surgery, many of these deformed fellow creatures have had their deformities more or less mitigated. It is well known that the limbs of hundreds of children have been straightened in the Royal Infirmary of Glasgow and other Institutions; that the operation of osteotomy has been successfully performed, and that many of these children would have remained helpless objects for life had their abnormal conditions not been more or less rectified. Yet we cannot suppose that the bones of such are as able to endure the tear and wear of human life as can those that have been more favourably situated. In view, then, of all the mental labour and scientific skill that have been expended in remedying this dire calamity, it is a very extraordinary fact, that in this utilitarian age every new scheme that can be conceived, and every new invention that can be applied in the unhealthy competition of the present day, is simply another method of robbing the food we daily use of its nutrient properties.

We seek to remedy the evil results, and leave the cause of those evils unaltered, untouched. Such is simply countenancing on a gigantic scale their manufacture, to multiply *ad infinitum* new subjects to fill our Infirmaries to overflowing to the exclusion of cases that these grand Institutions were intended for.

Probable Pathological Cause.—The question may now be asked —Is it an excess of acid that destroys in the blood the constituent elements of which the bones are composed? Gamgee (*Loc. Cit.*, p. 283) regards such an opinion as crude.*

In the rough experiments formerly referred to, we found that the bones of the sheep, ox, pig, and human being, after immersion for a given time, were more or less affected, and that in the vessels in which the larger proportion of sugar was used the degrading action was more active, and lime salts of the bones were dissolved, and held in chemical suspension. Now, in all the farinaceous foods there are certain constituents of these foods that are converted into sugar in the alimentary canal. If, in addition to these normal and properly-adjusted constituents, we introduce daily an additional quantity of sugar or any other substance, is it unreasonable to suppose that such will more or less influence the blood? If there is an excess of lime salts, these are secreted in some part of the body; and if there is an excess of acidulous matter we would naturally expect such to act as an irritant, which would tend to prevent the deposition in the bones of the molecules of calcareous matter; further, we would expect the dissolution of the already deposited calcareous ingredients from the same cause; and, if we could only realise how delicate are the chemical combinations of the matter of which food is composed, and what are the properly-adjusted equivalent parts in solution in the blood, then would we more accurately realise the minute chemical changes that are produced by the daily introduction into the body of an undue proportion of either tannic or acetic acids from the excessive use of wheaten bread, sugar, and tea. In this, as in other results of natural law, all changes are brought about by infinitesimal and inappreciable degrees. It is not the torrent of rushing waters that melts the mountain track; the infinitesimal, soft, pellucid rain-drop contains all the elements of dissolution; yea, even the most refractory minerals and metals yield to this invisible, yet majestic, power. If it were possible that man, aided by the latest discovery of Science, could discover the chemical combinations of the matters which form blood, or could he follow that silent, living stream rushing through the arterial passages; could he note their differentiation, to be again differentiated, and re-differentiated again and again; could he follow the flow of blood through that labyrinth of intricate ramifications of the body, with all the constituent elements that are required for the building of the frame, silently freeing itself of the atoms of matter, returning to be recuperated, to again emerge on its vital mission; and could he realise that in each half-minute of time the whole volume of blood may be said to emerge from, and to return and pass through the heart; could he realise how delicate these molecules of matter must be, how minute the proportion, and how exquisite the adaptation; then he would see how infinitesimal changes in the composition of the blood, may produce very great changes in the nutrition of tissue. Could man's intellect be thus aided, and thus brought into the presence of the immeasurable—such I venture to think would provoke reflection. He would realize that, let him but alter any one of these equivalents, an effect would be produced so minute that even aid with all appliances of modern invention would fail to detect the change, and yet the ceaseless stream of blood would carry the effect through all the ramifications of the bones. Alter any of Nature's adjusted proportions, and all require to be readjusted. If the blood has but added to it even an infinitesimal amount of acidulous matter more than is required to carry on the functions of life, is it not possible such may seriously affect nutrition? May not the acid incorporate itself with other constituents of the blood, and alter this fluid, which will then be carried by its circulation throughout the countless canals of the bones—canals so minute that it requires the high magnifying powers of the microscope to define their existence, yet each of these canals are surrounded by laminæ infinitely more minute, and the constituents of the laminæ are secreted and formed by the blood. It needs no language of mine to convey the simple truth that any kind of acid must have a more or less dissolving action upon the calcareous ingredients of the blood, and thus not only prevent their deposition, but also have an absorbing influence upon previously secreted earthy matters; and in proportion to its irritant and dissolving action is this metamorphism of the constituents brought about. We see the results, yet we cannot trace the transmutation of the elements of food; we know such goes on with mathematically-adjusted precision of detail, and that any interference with the quality of the blood must interfere with the nutrition not merely of the bones, but of all the tissues of the body—how metamorphosed we know not; as to the agent that transmits the earthy matters of which bone is composed, thanks to Harvey and others, we approximately know. How dissolved in the blood, or how combined, is quite unknown; and we cannot fail to realise how little even the most cultured mind knows.

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* In the at present unknown molecular actions by which the earth salts are united with the protoplasm in the formation of bone, it is extremely presumptious of any man to say that any of the suggested theories are crude. This is clearly shown by the numerous and varied views of the different authors who have investigated this intricate and complex subject. Indeed, the whole secret of the formation of bone is wrapped up in such minute chemical combinations, which, when discovered, will at one and the same time reveal how thin the veil is which intercepts a proper and an accurate conception of the molecular combinations, and how varied, dissimilar, and yet how simple these combinations are.

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